

Overview of California ISO Summer 2000 Demand Response Programs

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Abstract – This paper provides an overview of two trial demand response programs implemented by the California ISO during the summer 2000 period. These programs were implemented due to concerns that significant load growth in California and the western United States region coupled with limited new generation supplies could require curtailment of firm load during peak load periods in order to maintain system reliability. These programs were initiated to provide a venue for loads to compete with generation in California's deregulated wholesale energy supply market and thus provide an additional mechanism by which a proper load and resource balance might be maintained to avoid system reliability problems.

Keywords – Demand Response, Load Curtailment, Deregulation, Energy Markets, Competition

1. INTRODUCTION

Legislation deregulating the California electric system was enacted in 1996 after several years of consideration on the matter. The deregulated operation of the California electric system began March 31, 1998 under the auspices of the California Independent System Operator (CAISO). The CAISO was created through the legislation as a not-for-profit, public benefit corporation vested with the responsibility of operating the transmission system to assure open-access and to maintain system reliability.

To address the marketing side of the deregulated electric energy business, the legislation also created the California Power Exchange (PX) to operate the primary forward markets to match the needs of energy buyers and energy suppliers. However, the CAISO operates near-term (hour ahead and real time) energy markets which are necessary to eliminate energy imbalances and provide operational control of power flows and congestion on the transmission grid.

The legislative effort to deregulate the California electric system had an unintended effect in that it initially created uncertainty which stifled the development of new generation resources. Further, it mandated that the State's three investor-owned utilities (IOU's) divest themselves of a significant portion, if not all, of their generation assets and that they acquire the majority of their energy through the PX wholesale markets.

Additionally, the deregulation of the California electric system only occurred at the wholesale level,

leaving the retail energy consumers under a regulated rate structure with energy price caps until the transition from the regulated structure is complete. Thus, the California electric system deregulation model did not spawn significant competition of energy suppliers at the retail level or provide significant incentives or opportunities for retail consumers to participate in the energy markets. These factors have, for the most part, left the California retail electric consumer "cost insensitive" to what happens at the wholesale level. To date, only the smallest of the State's three IOU's has completed the transition, exposing its retail customers to the cost variability in the wholesale markets.

Concurrent with California's deregulation efforts, significant economic growth has been occurring within the State as well in many areas of the western United States. This economic growth has created additional needs for electric energy and has created new load which is competing for a finite level of generation resources. This has also diminished the level of imports from neighboring systems upon which California has historically relied. The resource supply situation in California is not expected to begin to abate until 2002 or 2003 when new generation resources are planned to come into service.

In the meantime, California's electrical energy needs are relying on an existing, aging generation base which is subject to numerous forced outages. California has recently seen its generation base erode due to some aged generation equipment being forced out of service because of safety considerations.

All of the above factors have set the stage for severe resource shortages and have increased the likelihood that shedding of firm load may become necessary to maintain operating margins and protect system reliability. One of the few options in the near-term to combat these problems is to enlist the services of curtailable loads for price stability and system reliability. This paper describes two demand response programs initiated by the CAISO for the summer 2000 period to serve these purposes.

2. DEMAND PROGRAM DESIGN

Beginning in late 1999, the CAISO evaluated forecast demands for the summer 2000 period under high and low forecast conditions. Based on operating experience during the summer of 1998, these forecasts included the impacts of reduced imports

from neighboring systems due to wide-spread hot conditions over the entire region. Given these forecasts and factoring in the 2,780 MW of interruptible load already under contract by the State's three IOU's, it was identified that significant additional curtailable load would be required in California for the summer 2000 period.

Thus early in 2000, the CAISO began formulation and development of demand response programs to solicit and provide the additional needed curtailable load. Based on the forecasts, a participation goal for new curtailable load of 1,000-1,500 MW was established. This was deemed a feasible objective given that there was about 4,000 MW of peak direct access load in the CAISO controlled grid which could potentially participate in the programs. Plans for two different demand response programs were developed. The two programs, while both seeking to reduce system load during peak periods, were designed to accommodate loads with different needs, operating capabilities, and characteristics.

The first program, the Participating Load Program, was designed as a market-based program whereby loads would compete with generation based on price in the ancillary services markets. The second program, the Demand Relief Program, was designed to provide a fixed payment for an identified level of load which could respond to curtailment orders issued by the CAISO based on system conditions. Both programs were initiated on a trial basis to establish the interest of loads in participating in such programs, to identify the feasibility of operating such programs, and to demonstrate the level of benefits derived. Both programs were planned to be operational and in effect from June 15 through October 15.

Participating Load Program

The Participating Load Program (also known as the A/S Load Program) was designed to allow loads to participate in the ancillary services markets, through a certified Scheduling Coordinator, to provide generation-like services for:

- non-spinning reserves
- replacement reserves
- supplemental energy

For this program, a goal of acquiring 400 MW of load participation was set.

Loads participating in the non-spinning and replacement reserves markets were limited to participation in the Day-Ahead and Hour-Ahead markets. Bidders for these services would be awarded a capacity payment if their bid was accepted, and given an energy payment if they were required to perform in real-time. Loads offering supplemental

energy were limited to participation in the real-time market, and would be given an energy payment if they were required to deliver energy. For all three services, bids would be evaluated on par with bids from generators and energy would be dispatched in real-time in the exact manner as for generators. All settlements were handled through the Scheduling Coordinator for the load.

To be accepted for participation in the A/S Load Program, a participant had to offer load, either individually or in aggregate, which could reduce demand by at least 1 MW. Additionally, the participant had to provide the necessary metering and telemetry equipment to provide real-time EMS visibility and verification. Loads participating in the non-spinning reserve market had to be capable of delivering individual load values to an Aggregated Load Meter Data Server (ALMDS) within a 1-minute time span, and provide 4-second maximum scan capability to the CAISO from the ALMDS. Loads participating in the replacement reserves and supplemental energy markets had to be capable of delivering individual load values to an ALMDS within a 5-minute time span, and provide 1-minute maximum scan capability to the CAISO from the ALMDS. Loads providing non-spinning and replacement reserves had to be certified to provide ancillary services and respond within 10 minutes of a dispatch instruction. Certification was not required to participate in the supplemental energy market.

Demand Relief Program

The Demand Relief Program (DRP) was designed to allow loads, not able to meet the requirements of or able to feasibly participate in the A/S Load Program, to offer a fixed level of demand which could be curtailed in response to a CAISO operating instruction. Load electing to participate in the DRP was awarded a monthly capacity payment if their bid was accepted. Participants were eligible for the full capacity payment regardless of whether called upon to perform. If called upon, however, the capacity payment was subject to reduction if the average performance for the month did not exceed 90% of the capacity bid. If called upon to perform in real-time, DRP loads were also awarded an energy payment based on their actual level of performance.

To be accepted for participation in the DRP, a participant had to offer load, either individually or in aggregate, which could reduce demand by at least 1 MW. The participating loads had to provide interval metering capable of providing settlement quality metering data, and had to work through a certified Scheduling Coordinator to schedule their load in the forward markets to unique load take-out points. Additionally, participation in the Demand

Relief Program was limited to “new” loads not participating in any another load program, either through the CAISO, one of the IOU’s load programs, or any voluntary load reduction programs.

Loads participating in the DRP had to be capable of curtailing load within 30 minutes of the CAISO issuing a curtailment order. DRP loads were subject to curtailment between 12:00 and 20:00 hours Monday through Friday, except Federal holidays, anytime the CAISO was in a Stage 1 Emergency (operating reserves below 7%) condition and the real-time energy supply market had been exhausted. DRP loads were also subject to curtailment for no less than 2 hours and up to 8 hours per day, for a maximum of 30 hours in any month.

Performance of DRP loads was established after-the-fact through the evaluation of the settlement quality interval meter data. Performance was gauged based on the ability of a participant to reduce its demand below a baseline, 10-day, hourly rolling average demand level and relative to the level of demand offered and bid into the program. Non-performance would subject a participant to loss of the capacity payment and termination from the program. All settlements were handled through the Scheduling Coordinator for the DRP load.

3. PROGRAM PARTICIPATION

Interest in the two demand response programs was mixed with bids received for the programs limited relative to the CAISO’s expectations. The bids received failed to provide the level of load curtailment which the CAISO had hoped to acquire.

The demand response programs were developed through a “fast track” effort in a fairly narrow time period. The limited participation in the two programs stemmed from the limited amount of time to market the programs and build customer interest. The “fast track” process likely prevented some prospective participants from submitting timely and responsive bids to the programs. Further, the telemetry requirements required for loads to participate in the ancillary services markets and its implementation aspects posed a barrier to participation in that program.

Nonetheless, for the A/S load program, five responsive bids were received and accepted. These five bids collectively offered the follow ranges of capacity for the three types of ancillary services:

	<u>Low</u>	<u>High</u>
Non-Spinning Reserves	118 MW	152 MW
Replacement Reserves	289 MW	468 MW
Supplemental Energy	289 MW	468 MW

The ranges in the offerings were the result of uncertainties by the bidders as to the exact level of load they could provide. For the most part, the bids received were “placeholder” bids representing end-use loads that the bidders (mostly energy service providers and load aggregators) had yet to sign-up or acquire due to the limited time to market the programs prior to the bid submittal deadline.

In the final analysis, only about 230 MW of the total capacity bid was “firmed-up” through agreements with end-use loads. Further, two of the bidders opted out. One bidder opted out of the A/S Load Program in favor of participation in the Demand Relief Program for which it had received favorable bid acceptance, and another elected to have its end-use customer load contract directly with the CAISO.

However, despite the prospects of having 230 MW of load in the A/S Load Program, none of the loads bid actually participated in the ancillary services markets during the summer 2000. The majority of the load offered under the program was load already participating in the IOU’s tariff-based interruptible load programs approved by the California Public Utilities Commission (CPUC). The ability of these loads to participate in the ancillary services market were sought through Advice Letters filed with the CPUC by two of the IOU’s. In its resolution on these Advise Letters, however, the CPUC held in abeyance the ability of such loads to participate in the ancillary services markets while also participating in the IOU’s tariff-based programs. In its findings, the CPUC noted concern that such loads could be paid due to participation in the markets while already being compensated by lower rates through participation in the IOU’s interruptible load programs. The CPUC also voiced concern about potential “gaming” due to participation in two programs since the various programs appeared to use different formula and criteria.

With regard to the Demand Relief Program, 67 bids representing 269 MW of load were received and evaluated. Additional bids were received, but were deemed non-responsive and not evaluated. The final evaluation resulted in only six bids being accepted for the program representing only 180 MW of load, far below the CAISO’s participation goal. The average capacity price for the accepted bids to the DRP was about \$36,000 per MW-month, with some bids being substantially higher. This average capacity bid price was deemed equivalent to a supplemental energy bid of \$226/MWh existing for the 160 hours that the DRP loads were available for use.

As for the A/S Load Program, many of the bids received for the DRP were “placeholder” bids

representing end-use loads that the bidders had yet to sign-up or acquire due to the limited time to market the programs prior to the bid submittal deadline. Further, the desire to solicit input from the CAISO stakeholders on the DRP resulted in the program being in a constant state of flux prior to the issuance of the request for bids. This created confusion about various aspects of the program and deterred some participant interest. Additionally, only a small percentage of loads suitable for participation in the DRP were direct access customers which could readily participate in the program. There was significant uncertainty as to how to market the program to IOU bundled customers, and this was an impediment to filling the bids.

By the start of the Demand Relief Program, the 180 MW of accepted bids dwindled to about 55 MW actual contracted load in the initial month of the program, and this increased to about 67 MW in the latter months. Only four participants (i.e., load aggregators) remained at the start of the program. This substantial decrease in expected capacity was largely due to the bids being based on aggressive marketing targets by the participants which could not ultimately be fulfilled.

Some of the load accepted for the program, however, had to opt-out due to other factors. Perhaps the most significant of these was the result of loads which planned to participate in the DRP by disconnecting load from the grid and serving it from back-up generation. This was a permissible action under the rules of the DRP. This process, however, ran afoul with the local air quality management districts (AQMDs) who deemed such use of back-up generation to be incompatible with the emissions permits issued for this generation. The local AQMDs did not deem participation in demand response programs, albeit only for grid emergency situations, a true emergency under the scope of the emissions permits.

Despite the rather meager amount of load ultimately contracted under the program, the CAISO proceeded with the activation of the Demand Relief Program and its utilization throughout the summer 2000 period. This was deemed appropriate given the trial nature of the program, the level of effort which had been invested to develop the program, and the desire to gain operational experience with this new program. The following sections detail use of the program and some lessons learned through this process.

4. DRP IMPLEMENTATION AND USE

The implementation of the Demand Relief Program presented some technical challenges with respect to

the CAISO issuing curtailment instructions to the participants and their end-use customers in a timely manner. The majority of load in the program was represented by load aggregators and energy service providers who had aggregated many small loads to fit the program's 1 MW minimum load participation requirement. For the most part, the end-use loads in the program were of a few hundred kilowatts in size, with a few in the low megawatt size range. The participating loads represented loads like municipal sewage pumps, municipal office lighting, oil well pumps, some oil or chemical refining loads, agricultural related loads, and the like.

The loads in the DRP were diversely spread throughout the central and southern California region and were generally not under centralized control. Control of most of the loads required manual interaction and involved a mobile workforce (i.e., non office environment) of hundreds of people which had to travel to various sites to initiate load interruption. This precluded the use of conventional e-mail, fax, or telephone communications, and the framework of the program and "fast track" development and implementation did not support the installation of specialized controls or equipment.

The solution to this communications problem was found in the form of alphanumeric pagers. Alphanumeric pagers are readily available, relatively low cost, portable, and well supported in the regions of California where the end-use participating loads existed. Alphanumeric pagers also had the advantage that they could be assigned to group e-page addresses or page-forwarding messaging systems. They allowed the transmittal of up to 240 character, English-text messages. Thus, complete and clearly understandable instructions could be conveyed through the alphanumeric pager technology. Moreover, they could provide communication to the end-use load participants with typically only a 1-2 minutes delay.

The process for sending curtailment notices at the CAISO was handled through the establishment of a DRP group e-page address within the corporation's e-mail system. The CAISO undertook only to directly send curtailment notices to no more than five e-page/e-mail addresses per participant. This generally included the DRP participant, their Scheduling Coordinator, and the affected IOU's to which the end-use participating loads were connected. The curtailment notices were also broadcast to the alphanumeric pagers of CAISO personnel involved in the operations, settlements, and compliance aspects of the program.

Due to the total number of alphanumeric pagers which had to be reached as part of the curtailment notification process, the primary burden of distributing curtailment messages was the responsibility of the DRP participant. Depending on the participant, various methods were employed to reach all of the alphanumeric pagers involved in the load curtailment process. Some participants elected to establish their own internal e-page forwarding system, some designed to utilize two-way pagers at their end-use participant's sites. Others contracted with commercial pager companies to provide a re-broadcast service which would forward the e-pages received from the CAISO.

The general form of curtailment notices sent via the alphanumeric pager process was as follows:

**Shed all DRP load at 14:00 hours.
Keep load off until 17:00 hours.**

Notices to extend a curtailment or terminate a curtailment earlier than indicated in the original curtailment notice were also sent using a comparable message to convey the new instruction. Reminder notices were also sent to allow loads to restore at the end of the curtailment period.

In addition to the e-page notification process, the CAISO also employed a follow-up telephone contact to one party associated with each DRP participant. This generally was the participant's Scheduling Coordinator or the participant itself. This follow-up telephone contact provided feedback and helped assure that the e-page notices had been received by the primary party responsible for coordinating communications with the end-use load participants.

The Demand Relief Program became available for use on June 15 and remained available through October 15. The DRP was utilized in every month during this period except October. Table 1 provides the utilization information concerning the program during the summer 2000 period. The nominal number of hours in which load could be curtailed under the program was 30 hours per month. However, for the half-months of June and October, utilization was limited to only 15 hours.

Month	Hours Available	Hours Used	Number of Events
June	15	15	3
July	30	16	4
August	30	30	8
September	30	24.5	5
October	15	0	0

Table 1: Demand Relief Program Utilization

The implementation of curtailments under the DRP were based on system operating reserve conditions. The CAISO as a control area operator and member of the Western Systems Coordinating Council (WSCC) follows and adheres to the WSCC Minimum Operating Reliability Criteria (MORC). The MORC requires each control area to maintain operating reserves equal to or greater than 7% of the control area load. Within the CAISO, emergencies of various stages were declared when operating reserves dropped below the MORC required level. The various emergency stages are defined as follows:

Stage 1: Operating Reserves <7%
Stage 2: Operating Reserves <5%
Stage 3: Operating Reserves <1.5%

The CAISO initiated curtailments under the Demand Relief Program at the bottom of a Stage 1 Emergency and just before entering a Stage 2 Emergency.

5. EXPERIENCE & LESSONS LEARNED

The level of load participation in the Demand Relief Program was fairly small and well below the goals set by the CAISO. Nonetheless, the operation of the program during the summer 2000 period provided both the CAISO and the participants in the program with some valuable experience in implementing and operating such a program.

Identification of load performance and compliance with the curtailment instructions is accomplished after-the-fact through the processing and validation of settlement quality meter data. Receipt of such data lags the operating day by 46-days and takes about an additional nine days to be resolved into a preliminary settlement invoice. Thus as of this writing, DRP performance is only fully known for the months of June and July, and partially known for the August period.

Performance statistics for the program (not presently releasable) indicate that the overall load compliance with the curtailment instructions was fairly disappointing for June, but showed definite improvement in July and as time progressed. Further, the results show that some participants had consistently good performance while others demonstrated mixed response performance throughout the program.

The poor performance in the initial half-month of operation can likely be attributed to a number of factors. One factor appears to have been the form and process of issuing curtailment instructions by the CAISO. This may have created misunderstanding by the end-use load participants as to the proper action to implement. Changes in the notification process

were revised beginning in July which resolved some of these issues.

Another factor may be the normal “learning curve” process by participants in getting use to and accustomed to an unfamiliar process. Further, some participants were impacted by equipment failures which prevented load from being curtailed as planned. Moreover, performance of at least one load aggregator was impacted by end-use load participants opting to drop out and not performing after operation of the program had begun. This left the aggregator with a larger imbalance between load contracted into the program and load actually curtailed.

Based on the operating experience with the Demand Relief Program during the summer 2000 period and the lessons learned, the CAISO is better equipped to develop and implement the program for the summer 2001 period. Perhaps the most significant lesson learned was that there was not sufficient time allowed to develop the program, market it, and to gain sufficient participation from loads. For this reason, the CAISO began development of the summer 2001 program in August, 2000. As of this writing, the CAISO has issued a draft proposal for the 2001 program and has held several meetings with stakeholders to review and solicit input on next year’s program design.

Another lesson learned from the 2000 DRP was that the process of issuing curtailment orders had to be kept simple, and the expected performance duration needed to be consistent. For this reason, the CAISO has proposed a fixed 4-hour interruption period for participating DRP loads which cannot be extended or shortened by subsequent curtailment instructions. This shorter performance period also better suits additional loads which could not fulfill the interruption requirements of the 2000 program which could be up to 8-hours in length.

Based on comments from participants in the 2000 program, the compliance calculation method is proposed to be modified in order to make the capacity payments under the program a linear function relative to actual performance rather than the stair-stepped performance evaluation guideline used for the 2000 program.

Additionally, it is proposed for the 2001 DRP to provide more compensation based on actual performance, and less on the capacity offered into the program. Moreover, the 2001 program will provide compensation during curtailment events for performance which is above the level contracted into the program, thus providing incentives for situations

where a load participant can supply more demand relief than contracted.

6. CONCLUSIONS

The CAISO’s Demand Relief Program for the summer 2000 period, while providing less demand relief than expected, was a successful trial program for fostering load participation into California’s otherwise wholesale energy market. The experience gained with the 2000 program provided the CAISO with some very useful insights on the operation of such a program, and has better prepared the CAISO to implement load curtailment programs for the 2001 summer season. Additionally, the participants in the program have gained a better understanding of the program functions, and are better equipped to market the program to new end-use load participants for the 2001 program. The experiences gained from the summer 2000 Demand Relief Program will prove valuable as the CAISO grapples with the many challenges foreseen for the 2001 summer season.

BIOGRAPHY

John H. Doudna (Senior Member, IEEE) received his BSEE degree from Iowa State University in 1974, with emphasis in power system engineering. He had 15-years experience in transmission planning with the Nebraska Public Power District, and served with Power Technologies, Inc. for 11 years in the consulting services group. He joined the California Independent System Operator in Folsom, CA in 2000 as an Operations Engineer involved in providing support for the real-time system operations functions. Mr. Doudna is a Registered Professional Engineer in the States of Nebraska and California.